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Cognitive developmental learning is a concept expressing the hypothesis that learning has a continuing, cumulative, and transformational function in the development of intelligence. Two important questions are, "How much do we know about methods?" and "What classes of knowledge and abilities should we develop?" An analysis of past investigations, including animal research, group educational projects, studies of sociopsychological variables, IQ tests, stimulation and measurement experiments, and methodological studies, indicates they are of limited use in exploring the sphere of cognitive developmental learning. Current research is aided by the advanced state of knowledge, convergence of learning and developmental theories, and intensive study of cognitive processes, but much of it concentrates on socially disadvantaged children. A systematic research utilizing dimensions for designing developmental stimulation programs could concentrate on the gifted child. Early and intensive stimulation and pervasive environmental arrangements provided by parents are factors of the gifted child's intelligence. Stimulation control over bright children is a compelling illustration of the proposition of the developmental learning hypothesis. Further research is needed. (DO)

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The Concept of Developmental Learning

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[1] This is a revision of a paper originally entitled "Early Educational Experience and the Development of Intelligence," presented at a symposium on "The Role of Experience in Intellectual Development," at the 133rd meeting of the American Association for the Advancement of Science, on Dec. 30, 1966, at Washington, D.C.

Cognitive developmental learning is a concept which expresses the hypothesis that learning has a continuing, cumulative and transformational function in the development of intelligence. It is an extension of the interactionist theory of development which defines intellectual functioning as a phenotypic activity system, at once the dynamic and developing product of, and the system which mediates cumulatively between, genotypic forces and environmental stimulation.

The importance of the developmental learning hypothesis is to be found first, in the necessary if not sufficient role assigned to stimulation in development--which is, of the two major variables in development, the one over which greater control can be exercised. Second, that explication of the role of stimulation requires tracing the course of an individual's development through the maze of specific stimulus events he encounters over his developmental life span. And, third, the impact of each stimulus event must be evaluated in terms of a pattern of interacting stimulus conditions in a framework of a dynamically active organism, making use of cognitive systems cumulatively acquired through previous encounters.

What this complicated formulation boils down to is the implication that the developmental learning hypothesis can never be completely tested unless complete control is gained over <u>all</u> sources of learning throughout the entire span of an individual's years of development. That is, we shall never know how <u>great</u> an influence stimulation can have in determining the level and forms of intellective abilities attainable, without control over <u>all</u> stimulus input in space and time.

To define such a perspective is to raise a number of problems of the Gordian knot variety. There is first of all an ethical question. Assuming the feasibility of such fine-grained control, are we entitled to play God of the computer? In our omnipotence, to program completely every individual's destiny? Where is the balance in the value equation of individual autonomy versus scientific "necessity." There is the equally enormous practical problem of the almost insuperable, physical impossibility of exerting such leverage over an individual's attention through every moment in time. How much do we know about methods? And, what is certainly both a practical and an ethical question, what classes of knowledge and abilities should we choose to develop? Even the highest magnitude of biological potential precludes more than vague acquaintance with the expanding sea of knowledge, the myriad of the world's languages, and a range of skills so diverse and possibly disjunctive as creative writing and administrative competence.

Yet, if life is not the laboratory, there may be available alternate strategies to the canon of absolute stimulus control, strategies which can combine ethical legitimacy and experimental productivity. The choice is not, after all, between absolute freedom and absolute control. Culture itself is a vehicle which not only permits, but defines a range and variety of stimulus forms which are highly influential in shaping the outcome of every member's intellectual status. In the social history of man, the home, the community and, later, the school have represented in the modes of child-rearing

each culture has selected various proportions of social-physical necessity and expedience, cultural accident tempered by the slow accretion of knowledge. The fact of decision-making with respect to the quality and quantity of stimulation provided each child in his development is inescapable. The technological proliferation of our world today may simply multiply our opportunities to make decisions and plans on more rational and human, than accidental grounds.

Experimental control in situ is nonetheless difficult. If massive control is ruled out, is there some basis for gaining selective control sufficiently powerful to produce consistent monumental effects? As in the realm of methods of observation, where it is neither possible nor useful to record everything, there may be certain strategic principles of stimulation that, once defined, are capable of generating programs which can determine the major portion of the stimulation variance. It is conceivable that certain environmental arrangements applied judiciously, especially at certain critical phases of development and pursued faithfully over the long haul, might regularly result in the launching and construction of cognitive processing systems of a high order.

Characteristics of Past Investigations

But where can we search to find these crucial principles for organizing cognitive stimulation programs? One obvious choice is to turn to the history of the experimental psychology of learning for the light it has had to shed upon education.

Here we can find numerous and often competing principles of learning, which, until recently with the impetus of national concern for problems of the socially disadvantaged, had seldom been subjected to experimental test in the sphere of cognitive, developmental learning. The methodological limitations of earlier research efforts have been discussed a number of times (Fowler, 1962a, 1967a, b & c). While there is no room in the present context to review these limitations, it may be useful to outline some of the main features of past projects to serve as a ground for illuminating a proposed set of principles of developmental stimulation.

The bulk of investigations on learning have been conducted in the experimental psychological laboratory, in school systems, or by taking correlational measures between social indices of stimulation and measures of intellectual ability and achievement. The first class of research has been conducted most often on animals and has employed a molecular focus, usually on single variables for extremely short time spans. The second category has operated within a framework of mass educational systems where the group has served as the instructional unit. Stimulation programs have been designed in the form of blocks of material to be covered in finite time periods, which tends to orient teaching to the lowest common denominator of classroom understanding, an approach which bores the more advanced and discourages the slow. Individual progress has been measured in terms of variations around a mean, to the neglect of evaluation in relation to standards derived from cumulative

developmental histories. Normal curve theory has been applied to small groups, explicitly or implicitly, with insufficient regard to the operation of specific treatment (i.e., stimulus) conditions and other obviously biasing factors.

In the third class of studies, rather broad socio-psychological variables, such as social class, mid-parent education level and adoptive child-rearing status have been related to broad measures of mental ability and achievement. In this approach there was little attempt to analyze stimulation in terms of specific characteristics or to refine measures of intellectual development.

The classical form of experimental investigation of intellectual developmental learning has been centered in the context of nursery school education. Generally, the effects of one or two years of nursery school attendance by two to five year-old children have been measured by means of standard IQ tests of intelligence. In balance, many studies of this kind carried out in the 1930's to the 1940's, despite methodological weaknesses, appeared to show consistent and significant IQ score gains of approximately 5 to 10 points over their non-school controls (Anastasi, 1958; Wellman, 1945). But the essential limitation of all such studies stemmed from the failure to go much beyond global definitions, either of treatment programs or of measures of intellectual ability. There was, accordingly, little or no possibility of experimental modification of the dimensions of stimulation as a result of and in order to alter variations in components of cognitive

PS001307

functioning. Although the nursery school movement may be said to have pioneered in flexible tailoring of program to individual differences in levels and styles of functioning, stimulation occurred as a package of diffuse, unanalyzed experiences. Moreover, although nursery school education made similar advancements in its emphasis on designing programs related to the sensori-motor, concrete, play-oriented and undifferentiated developmental characteristics of the young child, socio-emotional and expressive approaches tended to dominate at the expense of verbal and abstract, cognitive orientations.

Mental test measurement, on the other hand, has, until recently, preferred single indices of intelligence, a "g" factor, with which it is difficult to partial out antecedent-consequent relations. Measures have been rather unstable below age six (Bayley, 1955) and designed empirically on the basis of methodological criteria (age grading and test homogeneity), which have largely excluded the possibility of differentiation of ability functions and components (Meyers and Dingman, 1960). IQ measures have thus been based on different but undefined specific functions at different ages; they have generally been limited in their assessment of the complexity of cognitive processes in terms of logical structures or sequences; and they have been standardized without reference to individual differences in developmental history.

Scattered through the history of development learning experiments have been occasional longitudinal projects which have addressed themselves to more precise definitions at both

the stimulation and measurement ends of the process. Among a variety of studies on language (e.g., Dawe, 1942; Strayer, 1930) drawing, (Dubin, 1946), early reading (Brown, 1924; Davidson, 1931; Terman, 1918) and other areas, McGraw's (1935, 1939) study of the effects of systematic stimulation of motor skills in a controlled investigation of fraternal twins is among the most outstanding. In addition to its control features, it is noteworthy for the age of starting (birth), its duration (almost two years), the specificity of both training and measures, its follow-up (to age six) and to the intensity and regularity with which stimulation was provided (several hours a day, five days per week). The rather remarkable accomplishments of the trained twin in such complex, cognitively mediated motor skills as swimming, diving, tricycle riding, roller skating, climbing and stacking boxes in seriation before the age of 22 months compared dramatically with the mediocre accomplishments of his untrained (albeit fraternal) twin. The implications of these findings with respect to the early establishment of permanent learning sets is suggested by the trained twin's generally superior performance at the age of six, following four years without planned training for either twin. Despite some important studies of this kind, this class of study suffered from a lack of a conceptual framework which would permit relating specific task definitions of stimulation and achievement progress to cognitive mediational processes. What may be described as the close of an era (in the 1940's) of promising beginnings, floundered from an onslaught of methodlogical attacks (e.g.,

Goodenough and Maurer, 1940), principally because there were insufficient conceptual tools and apparatus with which to defend the studies. The same constraints inherent in descriptive empiricism, led both to globalistic stimulation programs and globalistic concepts and measures of intelligence, on the one hand, and to unclassified, if precise, specific-achievement oriented studies of developmental learning, on the other.

Current Research Developments

The apparent dawn of a new era promises to work radical changes, both in the sphere of measurement and in the field of experimental design of developmental learning programs. Aside from the impetus from political-social forces on the national and international scene leading to massive research efforts on compensatory education, the generally more advanced state of knowledge, the convergence of learning and developmental theories, and the current intensive study and conceptual elaboration of cognitive processes are probably primary moving agents. The field of mental test measurement has assumed new, more logical and differentiated forms under such test development programs as those of Meyers and his associates (1962, 1964) using a combination of Guilford's (1956, 1959) model of the structure of the intellect and factor analytic techniques. Similar endeavors are taking their point of departure from Piaget's (1952) theories of the development of cognitive operations (Church, 1964; Kohlberg, 1962; Uzgiris and Hunt, 1964). In addition, a whole host of experimental research is preoccupied with testing

and shaping Piaget's concepts and measures, or studying such related aspects of cognitive processes as those of cognitive style (Gardner et.al., 1959,1960; Kagan, Moss and Sigel, 1963; Witkin, 1962) and language structure (D'Asare and John, 1961; Kirk and McCarthy, 1961; Luria, 1961; Menyuk, 1964; Olim, 1965).

While a similar proliferation of energy is underway in the design and analysis of developmental stimulation projects, much of the current research is concentrated on remedial work on socially disadvantaged children. Although much may be gained in understanding the parameters of developmental learning from a focus on deprivation, this remains only one aspect of the larger question of how to maximize environmental control over developmental learning processes. Moreover, a number of studies appear to suffer from the same globalistic, descriptive-empirical approach which beset previous eras. Imprecisely defined variables of stimulation have been related to similarly traditional and/or inadequately analyzed instruments of mental measurement, both of which continue to preclude a detailed analysis of antecedent-consequent relations (Blatt and Garfunkel, 1965; Fowler, 1967b; Wilkerson, 1966; Gray and Klaus, 1966; Long, 1966; Strodtbeck, 1964; Weikart, 1964). This lack of definition may not only account for some of the disappointing results, where no difference is found between experimental and controls following two years of special training, (e.g., Blatt and Garfunkel, 1965), or gains of one year lag the next (e.g., Weikart, 1964) but, equally important, imprecision impedes the possibility of learning from the failures through analysis.

What appears to be needed at this juncture is the mounting of more systematic and precisely defined research efforts which would utilize, as a minimum, a number of central dimensions for designing developmental stimulation programs. If the present state of knowledge is yet primitive, it is still sufficiently adumbrated to suggest an outline for a few variables which, if not completely established, appear useful, require accountability and can be focused on for testing.

Child-rearing of the "Gifted" Child

One particularly rich but generally overlooked source of concepts for defining essential dimensions is the field of the "gifted" child. Traditionally defined with the biological bias implied by its label, and centering attention on the psychology of adjustment and achievement, little attention has been devoted to certain developmental learning circumstances commonly surrounding the environmental history of these children. Documented case reports in this field, which need backing by systematic research investigations, indicate the following set of orientations to have prevailed in the child-rearing of children of precocious ability (Fowler, 1962a; Fowler, 1967b and c).

Most prominent is the earliness and intensity with which stimulation has been applied. While the early history of many individuals who subsequently display superior ability is often enshrouded in obscurity, there are ample, well-documented cases, where systematic instruction of the infant proceeded almost from birth. Attention to stimulation was supplied frequently

and regularly, often on a number of occasions each day. From the evidence and theories we have on the role of early stimulus deprivation and the vital role that cognitive learning sets and styles may perform in the efficiency of problem-solving and the development of intellective processes (Fowler, 1966; Reese, 1963), the prevalence of stimulation so early and in such volume may be suspected as playing a crucial role in their acquisition of precocious ability. We may also observe the self-propelled motivational systems which appear early and frequently in the annals of "gifted" children. They often pass endless hours making highly complex, creative intellectual constructions when left to their own activities (Miles, 1954).

Yet there is also considerable evidence that stimulation seldom stops with the early phases, but is a <u>total</u> and <u>pervasive</u> set of environmental arrangements which adult guides set up for the child over long periods of his development. Stimulation is thus <u>longitudinal</u> and <u>continuous</u> as well as early and intensive. It is therefore difficult to sort out the conditions which may establish early sets from the reinforcing influences which continue in development. One reasonable interpretation is to assume that, while the establishment of efficient learning sets and styles early is productive, continuation of selective guidance is equally valuable to insure acquisition of concepts at more complex levels, a process of <u>developmental accumulation</u> and <u>transformation</u> which requires many years. Developmental learning may be viewed as a series of conceptual transformations

to successively higher levels of cognitive functioning, each stage of which is constructed of the slow, continuing and prolonged accretion of small examples and connectives leading to a shift in the organization of logical processes.

The pervasiveness of stimulation control exercised over the total milieu of bright children is one of the most compelling illustrations of our general propostion of the developmental learning hypothesis. Typically, the circumstances of the child's milieu are governed by the plans and values of a kind of family ethos in which the heavy and continuing immersion of the child's energies in selective patterns of living and learning is reinforced by certain subordinate arrangements. Among prevalent ones are a tendency for the child to be segregated from non-familial, peer relations and to pass much of his time in one-to-one relations tutorially or informally with adults. No doubt the special values and conditions which are found in greater frequency in the middle and upper class, especially in those of high educational and intellective status and aspiration, orientations which also fall most commonly upon first-born children, account for the noticeably greater proportion of high ability children which emerge from such families (Altus, 1966; Cox, 1926; Miles, 1954).

One of the most fascinating subclassifications of this type of phenomenon is to be found in instances in which a parent has predicted and deliberately set out to demonstrate the phenomenon. That is, the parent, usually a trained scientist or professional, has experimented systematically within

a framework that superior abilities can be produced by gaining a high degree of control over the child's developmental learning processes. This is to be distinguished from the apparently more common orientations, governing the parents' efforts described by Terman (1925) where a parent stimulates his child, either because he is predisposed to believe the child needs stimulation because he is gifted or he stimulates (often unwittingly) because it is intrinsic to his style of child-rearing. Among a number of highly succesful examples of this kind were John Stuart Mill (Cox, 1926) Karl Witte (Witte, 1914) James and William Thompson (Dolbear, 1912) Norbert Wiener (Wiener, 1953), Winiford Stoner (Stoner 1914), Viola Clerich (Dolbear, 1912) William Sidis (Sidis, 1911) and this investigator's daughter, Velia (1962b). While it would be a mistake to jump to the equation "developmental stimulation equals high ability or genius," on the basis of findings which are essentially an aggregate of experimental case studies, the heuristic value of these often carefully conceived and documented, exploratory studies should not be minimized.

Of additional trends which can be spotted, one of the most consistent is the large volume of symbolic forms of stimulation to which bright children are found to have been regularly exposed from their earliest infancy. Often there is a high stress upon the acquisition of graphic coding systems, particularly early reading (Fowler, 1962a) and sometimes musical or mathematical symbols, but in any case oral language stimulation in one or more of the three language domains is apparently universal in the group.

To this list of promising criteria may be added others which may be extrapolated from these and other more experimentally devised projects on developmental learning, including a series of my own research investigations in this sphere. More elaborate statements on the nature and value of these dimensions have been published elsewhere (Fowler, 1965; 1967a). These may be summarized briefly as follows: (1) attending to the conceptual structure and sequential complexity of systems of stimulation to facilitate learning by clarifying relationships and programming according to levels of conceptual complexity; (2) defining and adapting the forms of stimulation to the sensori-motor, infralogical and play-oriented modalities and levels of infants and young children; (3) leading the child toward abstract and logical systems of cognitive functioning by free use of verbal mediation anchored in sensori-motor modes; (4) pacing and tailoring stimulus presentation to each child's level and style of personality-cognitive functioning, to insure continuing and cumulative mastery, as well as to provide a means of continuing psychocognitive diagnosis; (5) designing learning tasks which draw the child's energies into an active problem-solving approach (against passively receptive styles) which also lead him to consider alternate solutions and classifications and thus to develop inquiring and creative approaches, and which demand and therefore develop analytic-synthesizing and abstract cognitive style strategies; and (6) defining a small group social psychological setting, which will at once take account of individualized autonomy in learning, yet provide for the development of

collaborative value orientations with peers in personality development.

These conditions have been included in varying degrees and combinations in my own investigations, so that, for example, it has not proved difficult to produce substantial gains in an advantaged three-year-old's grasp of conservation of number or to engage in the systematic production of early readers among 80% of the non-disadvantaged 3 to 5 year-olds, utilizing these principles. But what is being proposed here is a far broader proposition. What I am suggesting is a serious test of the total cognitive developmental learning hypothesis, a test which can only be run by designing longitudinal experiments which start from birth and bring all principles to bear on a continuing basis. Until such experiments with more than single cases are implemented we shall never know just what proportion of the nature-nurture ratio is governed by the cumulative role of developmental stimulation, and how much we are normatively depriving so many.

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